Europäisches Patentamt

European Patent Office

Office européen des brevets

(19)

(11) Publication number: **0 353 021 B2**

(12)

NEW EUROPEAN PATENT SPECIFICATION

(45) Date of publication of the new patent specification: 18.10.95

(51) Int. Cl.⁶: **A23L 3/34**

(21) Application number: 89307537.4

(22) Date of filing: 25.07.89

(54) Controlled environment transportation of respiring comestibles.

(30) Priority: 29.07.88 NZ 225620

(43) Date of publication of application:
31.01.90 Bulletin 90/05

(45) Publication of the grant of the patent:
31.03.93 Bulletin 93/13

(45) Mention of the opposition decision:
18.10.95 Bulletin 95/42

(84) Designated Contracting States:
AT BE CH DE ES FR GB GR IT LI LU NL SE

(56) References cited:
EP-A- 0 224 469   WO-A-87/05782
DE-A- 3 140 337   FR-A- 2 520 592
US-A- 3 102 779   US-A- 4 642 996

PATENT ABSTRACTS OF JAPAN, vol. 4, no.
151 (C-28)(633), 23 Oct. 1980

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EP 0 353 021 B2

Description

The present invention relates to improvements in and/or relating to the carriage of comestibles and/or plants whether cut or not (hereinafter simply "comestibles") and in particular to an apparatus applicable
5 thereto including containers and related means and methods.

In New Zealand Patent Specification No. 205453 (US patent 4642996, Australian patent 567966 and other equivalents thereto) there is disclosed a system utilising shipping containers whereby the respiring comestible is loaded into a container, the container is then sealed sufficiently to ensure that less oxygen from ambient air can diffuse into the container than is required for respiration by the comestible, flushing
10 the container (preferably with a nitrogen rich gas) to reduce the oxygen level in the container atmosphere below that of the ambient air and transporting the container while monitoring at least the carbon dioxide and oxygen levels (and preferably also the temperature) within the container and adjusting as necessary, (a) the oxygen content by positive infusion of ambient air into the container in response to such monitoring towards an optimum or predetermined value or range of values, (b) the carbon dioxide content by absorbing carbon
15 dioxide from the atmosphere in the container in response to such monitoring towards an optimum or predetermined value or range of values and (c) the temperature, if monitored, by refrigeration in response to such monitoring towards an optimum or predetermined value or range of values.

The present invention recognises that the system disclosed in the aforementioned patent specification can further be improved, in particular in relation to control of the carbon dioxide presence in the container.
20 It is also recognised that while a system in accordance with the present invention is most appropriate for use with shipping "containers" where there is a wish to obviate the need for the transportation of pressurised or liquefied gases therewith, such a system is equally appropriate in other carriage spaces, eg. the cargo hold of an aircraft, ship, train or the like and therefore for the purposes of the present specification the word "container" as used herein relates not only to shipping containers but to any means defining a
25 storage space for such comestibles.

In a system such as disclosed in the aforementioned patent specification the quantity of carbon dioxide capable of being absorbed is finite where reliance is placed upon a finite amount of a carbon dioxide absorbing medium such as, for example, a scrubbing unit including hydrated lime. Moreover there is also the prospect of carbon dioxide build up where for some reason or another a flow of the gaseous
30 environment of the container can not be ducted through any such carbon dioxide scrubbing device.

It is therefore an object of the present invention to provide a method and related apparatus which will provide some safeguard in the event the carbon dioxide content of the container rises above a desirable level.

Accordingly the present invention, in one aspect, provides a method of transporting a quantity of a
35 comestible which may be subject to degradation as a result of respiration during transportation, comprising the steps of:

(a) sealing or substantially sealing said quantity of the respiring comestible within a container, wherein "container" is defined as any means defining storage space for respiring comestibles, sufficiently to ensure that less oxygen of the ambient air can diffuse into the container than is required for full
40 respiration by the respiring comestible, flushing the container with an oxygen low or oxygen free gas so as to provide a reduced oxygen level in the sealed or substantially sealed container, such flushing occurring before, during and/or after said sealing or substantial sealing, and
(b) transporting the container with the respiring comestible therein while (i) monitoring the oxygen level within said container and automatically adjusting the oxygen level as necessary by a positive infusion of
45 ambient air into the container in response to such monitoring towards an optimum or predetermined value or range of values and (ii) monitoring the carbon dioxide level within said container and adjusting the carbon dioxide level as necessary in response to such monitoring towards and optimum or predetermined value or range of values without reliance upon flushing with an oxygen low or oxygen free gas, said adjustment being firstly by means of a scrubbing of the air within said container should said
50 carbon dioxide level rise above a first predetermined value, and, secondly, should said carbon dioxide level rise above a second higher predetermined value, by the positive infusion of ambient air into the container.

Preferably said container is refrigerated and there-is automatic adjustment of the temperature.

A further aspect of the present invention consists in an apparatus for transporting a quantity of respiring
55 comestibles which may be degraded by respiration, said apparatus comprising:

transportable means defining a volume of a gaseous environment for said comestibles capable of being substantially sealed and in which the comestibles to be transported can be carried;
means to seal or substantially seal said volume after loading with said comestibles such that less

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oxygen from the ambient air can diffuse into the environment than is required for the respiration;

means to enable flushing of the environment with an oxygen free or low gas to reduce the oxygen content thereof below that of ambient air;

means to monitor the oxygen content of the environment;

means to monitor the carbon dioxide content of the environment;

means responsive to the means to monitor said oxygen content to cause a positive infusion of ambient air into the environment should the oxygen content be or fall below a predetermined value;

means responsive to the means to monitor said carbon dioxide content to cause passage of gas within the environment through means to scrub at least some of the carbon dioxide therefrom should carbon dioxide content rise above a first predetermined value; and

means responsive to the means to monitor said carbon dioxide content to cause a positive infusion of ambient air into the environment should said carbon dioxide content not be maintained below a higher second predetermined value by said means to scrub at least some carbon dioxide from the environment.

Preferably said apparatus includes means to monitor the temperature of the environment and additionally means responsive to the means to monitor the temperature of the environment to adjust at least downwardly the temperature of the environment towards a predetermined value.

The environment may be within a container which defines a storage space for respiring comestibles.

A third aspect of the invention provides a gas controller for a container, wherein "container" is defined as any means defining a storage space for respiring comestibles, having means for extraction of CO_2 from the container air and means for exchange of ambient air with container air, said controller comprising:

a microprocessor, read-only memory and read-write memory connected to a common communication bus;

a carbon dioxide detector for monitoring the level of carbon dioxide in the container air;

an oxygen detector for monitoring the level of oxygen in the container air;

means for connecting the output of said detectors to said bus; and

an output port connected to said bus for output from said microprocessor of control signals which activate/deactivate said means for extraction and means for exchange;

wherein said microprocessor executes a program stored in said read-only memory which program:

(a) monitors said carbon dioxide and oxygen level;

(b) activates/deactivates said means for extraction if said carbon dioxide level rises above/falls below a predetermined carbon dioxide high limit or range of limits;

(c) activates/deactivates said means for exchange if said carbon dioxide level rises above/falls below a predetermined carbon dioxide high limit or range of limits; and

(d) activates/deactivates said means for exchange if said oxygen level falls below/rises above a predetermined oxygen level or range of levels.

One preferred form of the present invention will now be described with reference to the accompanying drawings in which:

Figure 1 is a block diagram of a controller which may be used to implement the present invention; and

Figures 2 and 3 are flow diagrams for portions of the controller microprocessor program.

The controller, hereinafter described, is now preferred to be used in connection with the container systems described in the aforementioned specifications, particularly with reference to Figures 1-7 of those specifications, as a replacement for the controller described in relation to Figures 8-10 of those specifications. Such figures and the description thereof is hereby herein incorporated by way of reference.

The controller is a microprocessor based unit which measures, controls, displays and logs levels of carbon dioxide and oxygen in a container as hereinbefore defined, particularly a refrigerated marine shipping container. Control of the gas levels may be achieved via solenoid valves built into the container and connected to the controller. In the case of CO_2, valves are provided to (i) allow passage of container air through a scrubber unit in order to prevent the CO_2 level of the container air rising above a predetermined level, and (ii) allow an infusion of ambient air to the container should the CO_2 level rise above a higher predetermined level, such as in the event of failure of the scrubber action. In the case of O_2, the external valves of (ii) allow an infusion of ambient air to the container in order to prevent the O_2 level of the container air from falling below a predetermined level. The controller is intended to be portable and of a size and shape to fit in the electrical power control box of such containers.

Referring to Figure 1, the controller schematically comprises a microprocessor 1 which operates according to a program stored in read-only memory 2. The microprocessor reads and writes to and from read/write memory 3 and a removable cassette in cassette unit 4. A gas pump 5 continuously draws air from the container through inlet 15 and consecutively through O_2 detector 6 and CO_2 detector 7. Outlet 16 may return the sampled air to the container or its surroundings. A temperature detector 8 monitors

approximately the temperature of the controller itself. Analog multiplexer 9 passes any of the three detector output signals to analog-to-digital converter 10 in response to commands by the microprocessor. The selected detector signal is then passed to the microprocessor on a common data/address bus 11.

Microprocessor 1 calculates actual CO_2 and O_2 levels by applying corrections to the detected levels as

5   necessary depending on the detectors used. The CO_2 and O_2 levels according to the most recent sample are then shown on display 12, and may at suitable intervals be stored on the cassette, in addition to the detected temperature and the time according to real time clock 13. The microprocessor compares the actual CO_2 and O_2 levels with predetermined setpoints, these being preferred levels which vary with particular comestibles. Action of the container valves is controlled by the microprocessor.

10   It has been practical to group comestibles commonly transported by container into two categories, having preferred CO_2 levels greater or less than 3% by volume of the container air. A high CO_2 limit is defined for each category, above which unacceptable damage to the comestibles occurs. When the preferred level is less than 3% the high limit is 5%, and when the preferred level is greater than 3% the high limit is 5% plus the preferred level.

15   That part of the microprocessor program which enacts the present invention will now be described with reference to the flow charts of figures 2 and 3.

In Figure 2, action may be taken in respect of the container CO_2 and O_2 levels, provided that the container is not undergoing defrosting. The microprocessor then proceeds to compare the CO_2 level with the CO_2 setpoint and then with the CO_2 high limit value. If the CO_2 high limit is exceeded, ambient air is

20   drawn into the container to lower the container air CO_2 level, otherwise the O_2 level is compared with the O_2 setpoint. CO_2 high limit control thus overrides O_2 level control. In making each comparison and operating valves if necessary, program execution passes to the routine shown in Figure 3.

Referring to Figure 3, the microprocessor calculates an error equal to the deviation of the CO_2 or O_2 level from the corresponding setpoint, and calculates a control value equal to the error magnitude less the

25   deadband amplitude. If the control value is negative the error is within the deadband and the existing valve status is maintained. If the control value is positive, the error is outside the deadband and action may be taken as follows. If the CO_2 level and setpoint are being compared, a positive error indicates that the level is undesirably high, and the scrubber valve should be opened or remain open, while a negative error indicates that the level is below the setpoint and the scrubber valve should be closed or remain closed. If

30   the O_2 level and setpoint are being compared, a positive error indicates that the level is above the setpoint and the external valve should be closed, while a negative error indicates that the level is undesirably low and the external valves should be opened or remain open.

Principal features of a specific embodiment of the invention will now be described. In this embodiment the microprocessor 1 is an Intel 8085 8-bit processor. The other components of the controller shown in

35   figure 1 interface with the data/address bus via an 8255 programmable peripheral interface, except that the external ports 15 include an 8251 programmable communications interface for connection of the controller to a further microprocessor if desired. The ROM 2 in which the microprocessor program is stored comprises two 32K 2732 EPROMS while the RAM 3 comprises a 2K 6116 static RAM. The analog multiplexer 9 and analog-to-digital converter 10 comprise 4051 and ADC0802 chips respectively. The

40   setpoints for a particular container load are stored in the cassette after input from a portable computer via the 8251 interface as noted above, an the controller cannot exercise the routine of figure 2 unless the cassette is in place. Deadband values (O_2:±0.3%, CO_2:±0.5%) are stored in the EPROMS and are not varied between loads.

A "Teledyne"*type A5 microfuel cell detects oxygen in the container air up to 25% by volume and with

45   10% accuracy of reading. The cell output is temperature dependent for which compensation is achieved via a thermistor in the cell output circuit.

A four filament "Gowmac"*thermal conductivity cell is used to detect the presence of carbon dioxide in the container air up to 25% by volume. Each filament of the detector comprises one arm of a resistance bridge, two filaments being used for gas measurement and two filaments for reference. Such a detector is

50   not intrinsically CO_2 sensitive but also reflects the O_2 and NO_2 levels of the container air. The microprocessor therefore compensates the conductivity cell output according to the detected O_2 level and an estimate of the N_2 level. The CO_2 detector is also temperature dependent for which further compensation is made by the microprocessor via the output of temperature detector 8. Overall, the CO_2 level obtained with 1%

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accuracy.

A "Wisa" * vibrator type pump draws container air through the detectors at 0.2-0.5 1/minute. The air is filtered before passage through the CO_2 detector.

Each detector output is read by the microprocessor approximately once every second and a running
5   average for each level is calculated to overcome noise, the detector outputs being compensated as noted previously. The latest averages are displayed on the front panel of the controller and compared with the setpoints. The container CO_2 and O_2 levels and controller temperature are recorded on the cassette approximately every 8 hours when the container and controller are in use. There is provision to monitor and record the temperature within the container through a further communications port in the container, not
10   shown in figure 1, if desired.

Appendix I is a portion of an 8085 assembly language program listing in which lines 222-335 correspond approximately to the flow chart of Figure 2.

Appendix II is a portion of an 8085 assembly language program listing in which lines 1134-1168 carry out CO_2 level compensation for the CO_2 detector temperature, lines 117-1200 carry out CO_2 level
15   compensation in accord with the O_2 level, and lines 1219-1272 correspond approximately to the flow chart of Figure 3.

It is believed that apparatus and methods in accordance with the present invention define widespread application in the transportation industry.

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* Wisa Precision Pumps Bayonne NJ 07002 USA

APPENDIX 1

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ISIS-II 8080/8085 MACRO ASSEMBLER, V4.1          TFCVF
RANGFRESH 300 SERIES CONTROLLER

    LOC  OBJ          LINE          SOURCE STATEMENT

    00C0 CD0506   C   214           CALL    LOG
    00C3 AF           215           XRA     A
    00C4 326400   D   216           STA     LOGF    ;AND RESET LOG FLAG
                      217
                      218 ; COMPENSATE AND SCALE INPUTS
    00C7 CDA006   C   219 MAIN1:    CALL    TFCMP
                      220
                      221 ; CONTROL OUTPUTS
    00CA 3A0430       222           LDA     PORTA
    00CD 47           223           MOV     B,A
    00CE E620         224           ANI     DFRST   ;DEFROSTING?
    00D0 CAA301   C   225           JZ      DPPTR   ;YES, EXIT
                      226
    00D3 78           227           MOV     A,B
    00D4 E680         228           ANI     CART    ;CARTRIDGE INSERTED
    00D6 C2A301   C   229           JNZ     DPPTR   ;NO, EXIT
                      230
                      231 ; DO CONTROL ACTION ON CO2
    00D9 110A40       232           LXI     D,ESPCO2 ;GET CO2 SET POINT
    00DC CD1E08   C   233           CALL    SPCV    ;CONVERT
                      234
    00DF 012300   D   235           LXI     B,TCO2   ;CO2 VALUE
    00E2 113300   D   236           LXI     D,TMP    ;SET POINT
    00E5 214300   C   237           LXI     H,DBCO2  ;DEADBAND
    00E8 3E00         238           MVI     A,0      ;NEGATIVE CONTROL ACTION
    00EA CD0807   C   239           CALL    CTLA
                      240
    00ED DA0201   C   241           JC      CON3
    00F0 79           242           MOV     A,C
    00F1 B7           243           ORA     A
    00F2 3A0530       244           LDA     PORTB
    00F5 CAFC00   C   245           JZ      CON1
    00F8 E6FB         246           ANI     NOT RYCO2
    00FA C3FF00   C   247           JMP     CON2
    00FD F604         248 CON1:     ORI     RYCO2
    00FF 320530       249 CON2:     STA     PORTB
                      250
    0102 213300   D   251 CON3:     LXI     H,TMP    ;CLEAR TEMP
    0105 0604         252           MVI     B,4
    0107 CD0000   E   253           CALL    CLRM
                      254
                      255 ;CHECK CO2 LIMIT
    010A 110A40       256           LXI     D,ESPCO2 ;GET CO2 SET POINT
    010D CD1E08   C   257           CALL    SPCV    ;CONVERT
                      258
                      259 ;      SET POINT < 3%
    0110 013300   D   260           LXI     B,TMP    ;SET POINT
    0113 114F00   C   261           LXI     D,PC3    ;- 3%
    0116 213700   D   262           LXI     H,TMP+4
    0119 CD0000   E   263           CALL    SUB32
    011C 3A3A00   D   264           LDA     TMP+7    ;GET SIGN BIT
    011F 0F           265           RRC              ;-VE
    0120 DA3501   C   266           JC      CON4     ;YES, SET TO 5%
                      267
                      268 ;      > 3% SET POINT = SET POINT + 5%
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IIS-II 8080/8085 MACRO ASSEMBLER, V4.1              TFCVF
TANSFRESH 300 SERIES CONTROLLER

LOC  OBJ          LINE        SOURCE STATEMENT

0123 013300  D  269         LXI   B,TMP    ;SET POINT =
0126 115300  C  270         LXI   D,PC5    ;SET POINT +
0129 215300  D  271         LXI   H,TMP+3  ;5%
012C CD0000  E  272         CALL  ADD32
012F 113800  D  273         LXI   D,TMP+3  ;-> SETPOINT + 5%
0132 C35801  C  274         JMP   CONS
                275
                276 ;          < 5% SET POINT = 5%
0135 115300  C  277 CON4:   LXI   D,PC5    ;-> 5%
                278
0138 012300  D  279 CONS:   LXI   B,TCO2   ;-> CO2 COMPENSATED
013B 214800  C  280         LXI   H,PC1    ;-> DEADBAND
013E 3E00       281         MVI   A,0      ;CONTROL +VE
0140 CDB807  C  282         CALL  CTLA
                283
                284 ;          DO CONTROL ACTION
0143 DA5801  C  285         JC    CON6     ;ACTION REQUIRED, NO ->
0146 79         286         MOV   A,C      ;ON OR OFF
0147 B7         287         ORA   A
0148 3A0550     288         LDA   PORTB    ;GET PORT
014B CA5301  C  289         JZ    CONA     ;OFF ->
014E E6FD       290         ANI   NOT RYTB ;LIMIT OFF
0150 C35501  C  291         JMP   CONB
0153 F602       292 CONA:   ORI   RYTB     ;LIMIT ON
0155 320550     293 CONB:   STA   PORTB
                294 ;
0158 3A0550     295 CON6:   LDA   PORTB    ;CHECK LIMIT
015B E602       296         ANI   RYTB     ;LIMIT SET?
015D CA6801  C  297         JZ    CONC     ;NO, CONT
0160 3A0550     298         LDA   PORTB    ;GET PORT AGAIN
0163 F601       299         ORI   RYO2     ;YES, SET RYO2
0165 320550     300         STA   PORTB
0168 C3A801  C  301         JMP   DPPTR    ;NEXT FUNCTION
                302
016B 213300  D  303 CONC:   LXI   H,TMP    ;CLEAR TEMP
016E 0608       304         MVI   B,8
0170 CD0000  E  305         CALL  CLRM
                306
                307 ;DO CONTROL ACTION ON OXYGEN
0173 110E40     308         LXI   D,ESPO2  ;OXYGEN SET POINT
0176 CD1E08  C  309         CALL  SPCV     ;CONVERT
                310
                311 ;POINT TO APPROPIATE O2 CELL FOR CONTROL
0179 210900  D  312         LXI   H,AO2A   ;-> O2A
017C 3A6700  D  313         LDA   O2CF     ;FLAG SET?
017F B7         314         ORA   A
0180 CA8601  C  315         JZ    CON7     ;NO, CONT
                316
0183 210F00  D  317         LXI   H,AO2B   ;YES POINT TO REF
                318
0186 44         319 CON7:   MOV   B,H      ;H,L -> O2 VALUE TO USE
0187 4D         320         MOV   C,L      ;TRANSFER TO B,C
0188 113300  D  321         LXI   D,TMP    ;-> O2 SET-POINT
018B 214700  C  322         LXI   H,DBO2   ;-> O2 DEAD BAND
018E 3EFF       323         MVI   A,OFFH
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SIS-II 6080/8085 MACRO ASSEMBLER, V4.1          TFCVF
RANSFRESH 300 SERIES CONTROLLER

LOC   OBJ          LINE        SOURCE STATEMENT

0170 CDDB07  C   324          CALL    CTLR
                 325
0173 DAA601  C   326          JC      DPPTR
0196 79          327          MOV     A,C
0197 B7          328          ORA     A
0198 3AC550      329          LDA     PORTB
019B CAA701  C   330          JZ      CON8
019E E6FE        331          ANI     NOT RYO2
01A0 C3A501  C   332          JMP     CON7
01A3 F601        333 CON8:    ORI     RYO2
01A5 320550      334 CON7:    STA     PORTB
                 335
                 336 ; SET DISPLAY POINTERS TO CO2 AND O2
01A8 112300  D   337 DPPTR:   LXI     D,TCO2  ;-> CO2 AVERAGE
01AB 210800  D   338          LXI     H,AO2A  ;-> O2A AVERAGE
01AE 3A6900  D   339          LDA     O2CF    ;O2 CONTROL FLAG
01B1 B7          340          ORA     A       ;SET7
01B2 CAB801  C   341          JZ      KPR     ;YES, LEAVE OA2
01B5 210F00  D   342          LXI     H,AO2B  ;NO, CHANGE TO O2B
                 343
                 344 ; ANY KEYS PRESSED
01B8 3A6500  D   345 KPR:     LDA     KEYF
01BB B7          346          ORA     A
01BC CA1F02  C   347          JZ      MAINS   ;NO, CONT
                 348
                 349 ; NOW SEE WHICH KEY
01BF 3A0430      350          LDA     PORTC   ;GET KEY
01C2 E60F        351          ANI     0FH     ;STRIP UPPER
01C4 210800  D   352          LXI     H,AO2A  ;-> O2A
01C7 110F00  D   353          LXI     D,AO2B  ;-> O2B
01CA FE0D        354          CPI     SWP1    ;O2A & O2B REQUIRED?
01CC CA0902  C   355          JZ      KPR1    ;YES, JUMP OUT
01CF 211300  D   356          LXI     H,AT1   ;NO, -> TEMP 1
01D2 111700  D   357          LXI     D,AT2   ;-> TEMP 2
01D5 FE07        358          CPI     SWP3
01D7 CA0902  C   359          JZ      KPR1
01DA 212700  D   360          LXI     H,TT4   ;TEMPS 3 & 4
01DD 111B00  D   361          LXI     D,AT3
01E0 FE0B        362          CPI     SWP4
01E2 CA0902  C   363          JZ      KPR1
01E5 B7          364          ORA     A       ;KEY RELEASED?
01E6 CA0902  C   365          JZ      KPR1    ;YES, EXIT
01E9 213300  D   366          LXI     H,TMP   ;CLEAR TEMP
01EC 0608        367          MVI     B,8
01EE CDC000  E   368          CALL    CLRM
01F1 110E40      369          LXI     D,ESPG2 ;O2 SET POINT
01F4 CD1E08  C   370          CALL    SPCV    ;CONVERT
01F7 3A3400  D   371          LDA     TMP+1   ;GET VALUE
01FA 323800  D   372          STA     TMP+5
01FD 110A40      373          LXI     D,ESPCO2 ;O2 SET POINT
0200 CD1E08  C   374          CALL    SPCV
0203 213700  D   375          LXI     H,TMP+4
0206 113300  D   376          LXI     D,TMP
                 377
                 378 ; KEY PRESSED
```

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APPENDIX 2

IS-II 8080/6085 MACRO ASSEMBLER, V4.1   TFCVF
ANSFRESH 300 SERIES CONTROLLER

```
LOC  OBJ            LINE      SOURCE STATEMENT

06FF 35             1120         DCR     M
0700 C28106  C      1121         JNZ     AVRG
                    1122
0703 3EFF           1123         MVI     A,0FFH   ;SET FIRST TIME FLAG
0705 326A00  D      1124         STA     FIRSTF
                    1125
                    1126 ;NOW COMPENSATE THE AVERAGE VALUES
                    1127 ;EXPAND TEMPERATURE SCALE
0708 011F00  D      1128 TFC2:   LXI     B,AT4    ;AVERAGE TEMP
070B 11B307  C      1129         LXI     D,THR    ; X 3 =
070E 212700  D      1130         LXI     H,TT4    ;TRUE TEMPERATURE
0711 CD0000  E      1131         CALL    MUL32
                    1132
                    1133 ;COMPENSATE CO2 FOR TEMPERATURE
0714 012700  D      1134         LXI     B,TT4    ;DELTA T
0717 11CB07  C      1135         LXI     D,K4
071A 213D00  D      1136         LXI     H,TMP1
071D CD0000  E      1137         CALL    SUB32
                    1138
0720 013D00  D      1139         LXI     B,TMP1   ;DELTA T X 200
0723 11CF07  C      1140         LXI     D,K5
0726 213300  D      1141         LXI     H,TMP
0729 CD0000  E      1142         CALL    MUL32
                    1143
072C 010700  D      1144         LXI     B,ACO2   ;CO2A X 1000
072F 11D307  C      1145         LXI     D,K6
0732 212300  D      1146         LXI     H,TCO2
0735 CD0000  E      1147         CALL    MUL32
                    1148
0738 012300  D      1149         LXI     B,TCO2   ;(CO2A X 1000)
073B 113300  D      1150         LXI     D,TMP    ;- ((TT4 - 64000) X 200)
073E 212300  D      1151         LXI     H,TCO2
0741 CD0000  E      1152         CALL    SUB32
                    1153
0744 012300  D      1154         LXI     B,TMP1   ;(TT4 - 64000)/569
0747 11D707  C      1155         LXI     D,K7
074A 213D00  D      1156         LXI     H,TMP1
074D CD0000  E      1157         CALL    DIV32
                    1158
0750 010307  C      1157         LXI     B,K6     ;1000 - (DELTA T - 64000)
0753 113D00  D      1160         LXI     D,TMP1   ;  ------------------
0756 213D00  D      1161         LXI     H,TMP1   ;         569
0759 CD0000  E      1162         CALL    SUB32
                    1163
075C 012300  D      1164         LXI     B,TCO2   ;A - 0.2(DELTA T)
075F 113D00  D      1165         LXI     D,TMP1   ;------------------
0762 212300  D      1166         LXI     H,TCO2   ; 1 - 0.0035(DELTA T)
0765 CD0000  E      1167         CALL    DIV32
                    1168
                    1169 ;COMPENSATE CO2 FOR O2 CONCENTRATION
0768 010B00  D      1170         LXI     B,AO2A   ;-> O2A
076B 3A6900  D      1171         LDA     O2CF     ;GET APPROPIATE
076E B7             1172         ORA     A        ;O2 READING
076F CA7507  C      1173         JZ      AVG1
0772 010F00  D      1174         LXI     B,AO2B
```

9

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ISIS-II 8080/8085 MACRO ASSEMBLER, V4.1          TFCVF
TRANSFRESH 300 SERIES CONTROLLER

  LOC   OBJ          LINE        SOURCE STATEMENT

                     1175
                     1176 ;COMPENSATE CO2 DATA
  0775  115807   C   1177 AVG1:       LXI     D,TEN       ;C2 / 10
  0778  213D00   D   1178           LXI     H,TMP1
  077B  CD0000   E   1179           CALL    DIV32
                     1180
  077E  012D00   D   1181           LXI     B,TCO2      ;CO2 + O2/10
  0781  113D00   D   1182           LXI     D,TMP1
  0784  213D00   D   1183           LXI     H,TMP1
  0787  CD0000   E   1184           CALL    ADD32
                     1185
  078A  013D00   D   1186           LXI     B,TMP1      ;(CO2 + O2/10) - 2(UNITS)
  078D  11AF07   C   1187           LXI     D,TWOU
  0790  213D00   D   1188           LXI     H,TMP1
  0793  CD0000   E   1189           CALL    SUB32
                     1190
  0796  013D00   D   1191           LXI     B,TMP1      ;(CO2 - 2 + O2/10)
  0799  11B707   C   1192           LXI     D,NINE      ;------------------
  079C  213D00   D   1193           LXI     H,TMP1      ;        9
  079F  CD0000   E   1194           CALL    DIV32
                     1195
  07A2  013D00   D   1196           LXI     B,TMP1      ;(CO2 - 2 + O2/10) X 10/9
  07A5  11BB07   C   1197           LXI     D,TEN
  07A8  212D00   D   1198           LXI     H,TCO2
  07AB  CD0000   E   1199           CALL    MUL32
                     1200
  07AE  C9           1201           RET
                     1202
  07AF  7C14         1203 TWOU:      DW      5244,0      ;TWO (UNITS)
  07B1  0000         
  07B3  0300         1204 THR:       DW      3,0         ;THREE
  07B5  0000         
  07B7  0900         1205 NINE:      DW      9,0         ;NINE
  07B9  0000         
  07BB  0A00         1206 TEN:       DW      10,0        ;TEN
  07BD  0000         
  07BF  ED17         1207 K1:        DW      6125,0      ;CONSTANT 1
  07C1  0000         
  07C3  39E8         1208 K2:        DW      22585,0     ;CONSTANT 2
  07C5  0000         
  07C7  1000         1209 K3:        DW      16,0        ;CONSTANT 3
  07C9  0000         
  07CB  00FA         1210 K4:        DW      64000,0     ;CONSTANT 4
  07CD  0000         
  07CF  1400         1211 K5:        DW      20,0        ;CONSTANT 5
  07D1  0000         
  07D3  E803         1212 K6:        DW      1000,0      ;CONSTANT 6
  07D5  0000         
  07D7  3902         1213 K7:        DW      569,0       ;CONSTANT 7
  07D9  0000         
                     1214
                     1215 ;*********************************************************
                     1216
                     1217 ;CLTA:-        CONTROL ACTION SUBROUTINE
                     1219
```

```
IIS-II 8080/8085 MACRO ASSEMBLER, V4.1          TFCVF
TANSFRESH 300 SERIES CONTROLLER
```

LOC	OBJ		LINE	SOURCE STATEMENT		
			1219	;ENTER:	BC -> INPUT VARIABLE	
			1220	;	DE -> SET-POINT VALUE	
			1221	;	HL -> DEADBAND VALUE	
			1222	;	A = CONTROL ACTION, 00=+VE, FF=-VE	
			1223			
			1224	;EXIT:	CARRY, NO ACTION ERROR<DEADBAND	
			1225	;	C = ACTION 00(OFF), FF(ON)	
			1226			
			1227	;--		
			1228			
07D8	F5		1229	CTLA:	PUSH	PSW	;SAVE ACTION
07DC	E5		1230		PUSH	H	;SAVE DEADBAND POINTER
			1231			
			1232		;ENTER3 WITH BC, DE SET	
07DD	213300	D	1233		LXI	H,TMP	;ERROR
07E0	CD00C0	E	1234		CALL	SUB32	
			1235			
07E3	AF		1236		XRA	A	;RESET
07E4	326800	D	1237		STA	NEGF	;NEGATIVE FLAG
			1238			
07E7	213600	D	1239		LXI	H,TMP+3	
07EA	7E		1240		MOV	A,M	;ERROR -VE?
07EB	07		1241		RLC		
07EC	D2FA07	C	1242		JNC	$+14	;NO, ->
07EF	3EFF		1243		MVI	A,OFFH	;YES,
07F1	326800	D	1244		STA	NEGF	;NEGATIVE FLAG
07F4	213300	D	1245		LXI	H,TMP	
07F7	CD0000	E	1246		CALL	COMPHL	;MAKE POSITIVE
			1247			
07FA	013300	D	1248		LXI	B,TMP	;ERROR
07FD	D1		1249		POP	D	;DEADBAND
07FE	213300	D	1250		LXI	H,TMP	;CONTROL REQUIRED
0801	CD0000	E	1251		CALL	SUB32	
			1252			
0804	3A3600	C	1253		LDA	TMP+3	;ERROR < DEADBAND?
0807	07		1254		RLC		
0808	C1		1255		POP	B	;GET ACTION
0809	D8		1256		RC		;ERROR < DEADBAND, RETURN
080A	78		1257		MOV	A,B	;ACTION + OR -
080B	B7		1258		ORA	A	
080C	CA1108	C	1259		JZ	$+5	;ACTION +,RETURN WITH 00H
080F	3EFF		1260		MVI	A,OFFH	;ACTION -,RETURN WITH OFFH
0811	4F		1261		MOV	C,A	;PUT ACTION IN C
			1262			
0812	3A6800	D	1263		LDA	NEGF	;WAS ERROR -VE?
0815	B7		1264		ORA	A	
0816	CA1C08	C	1265		JZ	$+6	;NO, ->
0819	79		1266		MOV	A,C	;YES, COMPLEMENT
081A	2F		1267		CMA		
081B	4F		1268		MOV	C,A	
			1269			
081C	AF		1270		XRA	A	;CLEAR ACTION FLAG
081D	C9		1271		RET		
			1272			
			1273	;--		

Claims

1. A method of transporting a quantity of a comestible which may be subject to degradation as a result of respiration during transportation, comprising the steps of:
    (a) sealing or substantially sealing said quantity of the respiring comestible within a container, wherein 'container' is defined as any means defining storage space for respiring comestibles, sufficiently to ensure that less oxygen of the ambient air can diffuse into the container than is

required for full respiration by the respiring comestible, flushing the container with an oxygen low or oxygen free gas so as to provide a reduced oxygen level in the sealed or substantially sealed container, such flushing occurring before, during and/or after said sealing or substantial sealing, and (b) transporting the container with the respiring comestible therein while (i) monitoring the oxygen level within said container and automatically adjusting the oxygen level as necessary by a positive infusion of ambient air into the container in response to such monitoring towards an optimum or predetermined value or range of values and (ii) monitoring the carbon dioxide level within said container and adjusting the carbon dioxide level as necessary in response to such monitoring towards and optimum or predetermined value or range of values without reliance upon flushing with an oxygen low or oxygen free gas, said adjustment being firstly by means of a scrubbing of the air within said container should said carbon dioxide level rise above a first predetermined value, and, secondly, should said carbon dioxide level rise above a second higher predetermined value, by the positive infusion of ambient air into the container.

2. A method as claimed in claim 1 wherein said container is refrigerated and there is automatic adjustment of the temperature.

3. Apparatus for transporting a quantity of respiring comestibles which may be degraded by respiration, said apparatus comprising:

transportable means defining a volume of a gaseous environment for said comestibles capable of being substantially sealed and in which the comestibles to be transported can be carried;

means to seal or substantially seal said volume after loading with said comestibles such that less oxygen from the ambient air can diffuse into the environment then is required for the respiration;

means to enable flushing of the environment with an oxygen free or low gas to reduce the oxygen content thereof below that of ambient air;

means to monitor the oxygen content of the environment;

means to monitor the carbon dioxide content of the environment;

means responsive to the means to monitor said oxygen content to cause a positive infusion of ambient air into the environment should the oxygen content be or fall below a predetermined value;

means responsive to the means to monitor said carbon dioxide content to cause passage of gas within the environment through means to scrub at least some of the carbon dioxide therefrom should said carbon dioxide content rise above a first predetermined value; and

means responsive to the means to monitor said carbon dioxide content to cause a positive infusion of ambient air into the environment should said carbon dioxide content not be maintained below a higher second predetermined value by said means to scrub at least some carbon dioxide from the environment.

4. Apparatus as claimed in claim 3 wherein said environment is within a container which defines a storage space for respiring comestibles.

5. Apparatus as claimed in claim 3 wherein there is provided means to monitor the temperature of the environment and additionally means responsive to the means to monitor the temperature of the environment to adjust at least downwardly the temperature of the environment towards a predetermined value.

6. A gas controller for a container, wherein "container" is defined as any means defining a storage space for respiring comestibles, having means for extraction of CO_2 from the container air and means for exchange of ambient air with container air, said controller comprising:

a microprocessor, read-only memory and read-write memory connected to a common communication bus;

a carbon dioxide detector for monitoring the level of carbon dioxide in the container air;

an oxygen detector for monitoring the level of oxygen in the container air;

means for connecting the output of said detectors to said bus; and

an output port connected to said bus for output from said microprocessor of control signals which activate/deactivate said means for extraction and means for exchange;

wherein said microprocessor executes a program stored in said read-only memory which program:

(a) monitors said carbon dioxide and oxygen level;

(b) activates/deactivates said means for extraction if said carbon dioxide level rises above/falls below a predetermined carbon dioxide level or range of levels;

(c) activates/deactivates said means for exchange if said carbon dioxide level rises above/falls below a predetermined carbon dioxide high limit or range of limits exceeding said carbon dioxide level or range of levels; and

(d) activates/deactivates said means for exchange if said oxygen level falls below/rises above a predetermined oxygen level or range of levels.

7. A gas controller according to claim 6 wherein said activation/deviation comprises opening/closing of solenoid valves.

8. A gas controller according to claim 6 or claim 7 wherein said predetermined levels are preferred levels for transport of respiring comestibles within said container.

9. A gas controller according to any one of claims 6 to 8 wherein said predetermined carbon dioxide limit is a limit above which unacceptable damage occurs to comestibles being transported in said container.

10. A gas controller according to any one of claims 6 to 9 wherein said means for connecting the output of said detectors to said bus comprises an analog multiplexer in series with an analog-to-digital converter.

11. A gas controller according to any one of claims 6 to 10 wherein said program records at predetermined intervals said carbon dioxide an oxygen levels in a removable memory element connected to said microprocessor via said bus.

Patentansprüche

1. Verfahren zum Transport einer Menge eines Lebensmittels, das sich während des Transports infolge Atmung zersetzen kann, umfassend die folgenden Schritte:

(a) die Menge des atmenden Lebensmittels in einem Behälter dicht oder im wesentlichen dicht verschließen, wobei "Behälter" definiert ist als jede Einrichtung, die einen Lagerraum für atmende Lebensmittel aufweist, der mit hinreichender Sicherheit gewährleistet, daß weniger Sauerstoff aus der Umgebungsluft in den Behälter eindringen kann als von dem atmenden Lebensmittel zur vollständigen Atmung benötigt wird, Spülen des Behälters mit einem sauerstoffarmen oder sauerstofffreien Gas, so daß in dem dicht oder im wesentlichen dicht verschlossenen Behälter ein verminderter Sauerstoffgehalt erreicht wird, wobei das Spülen vor, während und/oder nach dem dichten oder im wesentlichen dichten Verschließen erfolgt, und

(b) Transportieren des Behälters mit dem darin enthaltenen atmenden Lebensmittel, während (i) der Sauerstoffgehalt in dem Behälter überwacht und der Sauerstoffgehalt nach Bedarf entsprechend dieser Überwachung durch zwangsläufiges Einleiten von Umgebungsluft in den Behälter automatisch auf einen optimalen oder vorbestimmten Wert oder Wertebereich reguliert wird, und (ii) Überwachen des Kohlendioxidgehalts in dem Behälter und Regulieren des Kohlendioxidgehalts nach Bedarf entsprechend dieser Überwachung auf einen optimalen oder vorbestimmten Wert oder Wertebereich, ohne daß zu diesem Zweck mit einem sauerstoffarmen oder sauerstofffreien Gas gespült wird, wobei die Regulierung zunächst durch Waschen der in dem Behälter befindlichen Luft erfolgt, wenn der Kohlendioxidgehalt über einen ersten vorbestimmten Wert ansteigt, und zweitens, wenn der Kohlendioxidgehalt über einen zweiten höheren vorbestimmten Wert ansteigt, durch zwangsläufiges Einleiten von Umgebungsluft in den Behälter.

2. Verfahren nach Anspruch 1, bei dem der Behälter gekühlt wird und eine automatische Temperaturregelung erfolgt.

3. Verfahren zum Transport einer Menge atmender Lebensmittel, die sich durch Atmung zersetzen können, wobei die Vorrichtung folgendes umfaßt:

eine transportable Einrichtung, die ein Volumen einer gasförmigen Umgebung für die Lebensmittel aufweist, das im wesentlichen dicht verschlossen werden kann, und in dem die zu transportierenden Lebensmittel getragen werden können;

eine Einrichtung, mit der das Volumen bzw. der Hohlraum nach dem Beschicken mit den Lebensmitteln dicht oder im wesentlichen dicht verschlossen wird, so daß weniger Sauerstoff aus der Umgebungsluft

in den Hohlraum eindringen kann als für die Atmung erforderlich ist;

eine Einrichtung, mit der der Hohlraum mit einem sauerstofffreien oder sauerstoffarmen Gas gespült werden kann, um seinen Sauerstoffgehalt unter den der Umgebungsluft abzusenken;

eine Einrichtung zur Überwachung des Sauerstoffgehalts in dem Hohlraum;

5 eine Einrichtung zur Überwachung des Kohlendioxidgehalts in dem Hohlraum;

eine Einrichtung, die in Abhängigkeit von der Einrichtung zur Überwachung des Sauerstoffgehalts eine zwangsläufige Einleitung von Umgebungsluft in den Hohlraum veranlaßt, wenn der Sauerstoffgehalt einen vorbestimmten Wert besitzt oder unter diesen abfällt;

eine Einrichtung, die in Abhängigkeit von der Einrichtung zur Überwachung des Kohlendioxidgehalts
10 Gas in dem Hohlraum durch die Einrichtung strömen läßt, um wenigstens etwas von dem Kohlendioxid herauszuwaschen, wenn der Kohlendioxidgehalt über einen ersten vorbestimmten Wert ansteigt; und

eine Einrichtung, die in Abhängigkeit von der Einrichtung zur Überwachung des Kohlendioxidgehalts eine zwangsläufige Einleitung von Umgebungsluft in den Hohlraum veranlaßt, wenn der Kohlendioxidgehalt von der Einrichtung, die wenigstens etwas von dem Kohlendioxid aus dem Hohlraum herauswäscht, nicht unter einem höheren zweiten vorbestimmten Wert gehalten wird.
15

4. Vorrichtung nach Anspruch 3, bei der der Hohlraum sich in einem Behälter befindet, der einen Lagerraum für atmende Lebensmittel aufweist.

20 5. Vorrichtung nach Anspruch 3, bei der eine Einrichtung zur Überwachung der Temperatur in dem Hohlraum vorgesehen ist und außerdem eine Einrichtung, die in Abhängigkeit von der Einrichtung zur Überwachung der Temperatur in dem Hohlraum die Temperatur in dem Hohlraum wenigstens nach unten auf einen vorbestimmten Wert reguliert.

25 6. Gasregler für einen Behälter, wobei "Behälter" definiert ist als jede Einrichtung, die eine Lagerraum für atmende Lebensmittel aufweist, umfassend eine Einrichtung zum Extrahieren von CO_2 aus der Behälterluft und eine Einrichtung zum Austausch von Umgebungsluft mit Behälterluft, wobei der Regler folgendes umfaßt:

einen Mikroprozessor, einen Nur-Lese-Speicher und einen Schreib-Lese-Speicher, die mit einem
30 gemeinsamen Datenübertragungsbus verbunden sind;

eine Kohlendioxiddetektor zur Überwachung des Kohlendioxidgehalts in der Behälterluft;

einen Sauerstoffdetektor zur Überwachung des Sauerstoffgehalts in der Behälterluft;

eine Einrichtung, die den Ausgang der Detektoren mit dem Bus verbindet; und

einen Ausgabebaustein, der mit dem Bus verbunden ist, um von dem Mikroprozessor Steuersignale
35 abzusetzen, die die Extraktionseinrichtung und die Austauscheinrichtung aktivieren bzw. deaktivieren;

wobei der Mikroprozessor ein Programm ausführt, das in dem Nur-Lese-Speicher gespeichert ist, wobei das Programm

a) den Kohlendioxidgehalt und den Sauerstoffgehalt überwacht;

b) die Extraktionseinrichtung aktiviert bzw. deaktiviert, wenn der Kohlendioxidgehalt einen vorbe-
40 stimmten Wert oder Wertebereich übersteigt oder unter diesen abfällt;

c) die Austauscheinrichtung aktiviert bzw. deaktiviert, wenn der Kohlendioxidgehalt einen vorbestimmten Höchstwert oder Grenzwertbereich für den Kohlendioxidgehalt übersteigt oder unter diesen abfällt, der höher ist als der genannte Wert oder Wertebereich; und

d) die Austauscheinrichtung aktiviert bzw. deaktiviert, wenn der Sauerstoffgehalt unter einen vorbe-
45 stimmten Wert oder Wertebereich absinkt oder diesen übersteigt.

7. Gasregler nach Anspruch 6, bei dem das Aktivieren/Deaktivieren das Öffnen/Schließen von Magnetventilen umfaßt.

50 8. Gasregler nach Anspruch 6 oder Anspruch 7, bei dem die vorbestimmten Werte bevorzugte Werte für den Transport atmender Lebensmittel in dem Behälter sind.

9. Gasregler nach einem der Ansprüche 6 bis 8, bei dem der vorbestimmte Kohlendioxidgrenzwert ein Grenzwert ist, über dem die in dem Behälter transportierten Lebensmittel in inakzeptabler Weise
55 beschädigt werden.

10. Gasregler nach einem der Ansprüche 6 bis 9, bei dem die Einrichtung zum Verbinden des Ausgangs der Detektoren mit dem Bus einen Analogmultiplexer umfaßt, der mit einem A/D-Wandler in Reihe

geschaltet ist.

11. Gasregler nach einem der Ansprüche 6 bis 10, bei dem das Programm in vorbestimmten Abständen den Kohlendioxid- und Sauerstoffgehalt in ein herausnehmbares Speicherelement schreibt, das über den Bus mit dem Mikroprozessor verbunden ist.

Revendications

1. Procédé de transport d'une quantité d'un produit comestible pouvant être sujet à altération en résultat d'une respiration durant le transport, comportant les étapes consistant à:

(a) enfermer hermétiquement ou sensiblement hermétiquement ladite quantité du produit comestible respirant à l'intérieur d'un récipient, ledit "récipient" étant défini comme étant un moyen quelconque délimitant une chambre de stockage pour des produits comestibles respirants, suffisamment pour assurer que moins d 'oxygène de l'air ambiant que la quantité nécessaire pour une respiration complète du produit comestible respirant puisse diffuser dans le récipient, balayer le récipient avec un gaz pauvre en oxygène ou sans oxygène de manière à assurer un taux d'oxygène réduit dans le récipient hermétique ou sensiblement hermétique, un tel balayage se produisant avant, durant et/ou après ledit enfermement hermétique ou sensiblement hermétique, et

(b) transporter le récipient contenant le produit comestible respirant tout en (i) contrôlant le taux d'oxygène à l'intérieur dudit récipient et en réglant automatiquement le taux d'oxygène nécessaire par une injection positive d'air ambiant dans le récipient en réponse à ce contrôle vers une valeur ou fourchette de valeurs optimal ou prédéterminée et (ii) en contrôlant le taux de gaz carbonique à l'intérieur dudit récipient et en réglant le taux de gaz carbonique nécessaire en réponse à ce contrôle vers une valeur ou une fourchette de valeurs optimal ou prédéterminée indépendamment du balayage par un gaz pauvre en oxygène ou sans oxygène, ledit réglage étant tout d'abord effectué par épuration de l'air à l'intérieur dudit récipient au cas où ledit taux de gaz carbonique s'élève au-dessus d'une première valeur prédéterminée, et,en second lieu, au cas où ledit taux de gaz carbonique s'élève au-dessus d'une seconde valeur prédéterminée supérieure, par l'injection positive d'air ambiant dans le récipient.

2. Procédé selon la revendication 1, dans lequel ledit récipient est réfrigéré et possède un réglage automatique de la température.

3. Dispositif de transport d'une quantité de produits comestibles respirants pouvant être altérés par respiration, ledit dispositif comportant:

des moyens transportables délimitant un volume d'environnement gazeux pour lesdits produits comestibles pouvant être fermé pratiquement hermétiquement,et dans lesquels les produits comestibles devant être transportés peuvent être contenus;

des moyens pour fermer hermétiquement ou sensiblement hermétiquement ledit volume après chargement desdits produits comestibles de telle sorte que moins d'oxygène de l'air ambiant que la quantité nécessaire pour la respiration puisse diffuser dans l'environnement ;

des moyens permettant un balayage de l'environnement avec un gaz pauvre en oxygène ou sans oxygène pour réduire la teneur en oxygène de celui-ci au-dessous de celle de l'air ambiant;

des moyens pour contrôler la teneur en oxygène de l'environnement;

des moyens pour contrôler la teneur en gaz carbonique de l'environnement;

des moyens sensibles aux moyens pour contrôler la teneur en oxygène pour provoquer une injection positive d'air ambiant dans l'environnement au cas où la teneur en oxygène est ou tombe au-dessous d'une valeur prédéterminée;

des moyens sensibles aux moyens pour contrôler ladite teneur en gaz carbonique pour provoquer un passage de gaz à l'intérieur de l'environnement à travers des moyens d'épuration d'au moins une partie du gaz carbonique de ceux-ci au cas où ladite teneur en gaz carbonique s'élève au-dessus d'une première valeur prédéterminée; et

des moyens sensibles aux moyens pour contrôler ladite teneur en gaz carbonique pour provoquer une injection positive d'air ambiant dans l'environnement au cas où ladite teneur en gaz carbonique n'est pas maintenue au-dessous d'une seconde valeur prédéterminée supérieure par lesdits moyens d'épuration d'au moins une partie du gaz carbonique de l'environnement.

4. Dispositif selon la revendication 3, dans lequel ledit environnement se trouve à l'intérieur d'un récipient délimitant une chambre de stockage pour des produits comestibles respirants.

5. Dispositif selon la revendication 3, dans lequel sont prévus des moyens pour contrôler la température de l'environnement et de plus des moyens sensibles aux moyens contrôlant la température de l'environnement pour régler au moins à la baisse la température de l'environnement vers une valeur prédéterminée.

6. Contrôleur de gaz pour un récipient, dans lequel ledit "récipient" est défini comme étant un moyen quelconque délimitant une chambre de stockage pour des produits comestibles respirants, possédant des moyens pour une extraction de CO_2 de l'air du récipient et des moyens d'échange d'air ambiant avec l'air du récipient, ledit contrôleur comportant:
    un microprocesseur, une mémoire morte et une mémoire de lecture-écriture connectés à un bus de communication commun;
    un détecteur de gaz carbonique pour contrôler le taux de gaz carbonique dans l'air du récipient;
    un détecteur d'oxygène pour contrôler le taux d'oxygène dans l'air du récipient;
    des moyens pour relier la sortie desdits détecteurs audit bus; et
    un point de connexion de sortie relié audit bus pour une délivrance depuis ledit microprocesseur de signaux de commande qui activent/désactivent lesdits moyens d'extraction et lesdits moyens d'échange:
    dans lequel ledit microprocesseur exécute un programme mémorisé dans ladite mémoire morte, lequel programme:
    (a) contrôle ledit taux de gaz carbonique et d'oxygène;
    (b) active/désactive lesdits moyens d'extraction si ledit taux de gaz carbonique s'élève au-dessus de/s'abaisse au-dessous d'une limite ou fourchette de limites de gaz carbonique prédéterminées;
    c) active/désactive lesdits moyens d'échange si ledit taux de gaz carbonique s'élève au-dessus de / s'abaisse au-dessous d'une limite ou fourchette de limites supérieure de gaz carbonique prédéterminées dépassant ladite limite ou fourchette de limites de gaz carbonique.
    d) active/désactive lesdits moyens d'échange si ledit taux d'oxygène tombe au-dessous/s'élève au-dessus d'un taux ou d'une fourchette de taux d'oxygène prédéterminés.

7. Contrôleur de gaz selon la revendication 6, dans lequel ladite activation/désactivation comporte l'ouverture/fermeture d'électro-vannes.

8. Contrôleur de gaz selon la revendication 6 ou la revendication 7, dans lequel lesdits taux prédéterminés sont des taux préférés pour un transport de produits comestibles respirants à l'intérieur dudit récipient.

9. Contrôleur de gaz selon l'une quelconque des revendications 6 à 8, dans lequel ladite limite prédéterminée de gaz carbonique est une limite au-dessus de laquelle une détérioration inadmissible est provoquée pour des produits comestibles transportés dans ledit récipient.

10. Contrôleur de gaz selon l'une quelconque des revendications 6 à 9, dans lequel lesdits moyens reliant la sortie desdits détecteurs audit bus comportent un multiplexeur analogique en série avec un convertisseur analogique-numérique.

11. Contrôleur de gaz selon l'une quelconque des revendications 6 à 10, dans lequel ledit programme enregistre à des intervalles prédéterminés lesdits taux de gaz carbonique et d'oxygène dans un élément de mémoire amovible connecté audit microprocesseur par l'intermédiaire dudit bus
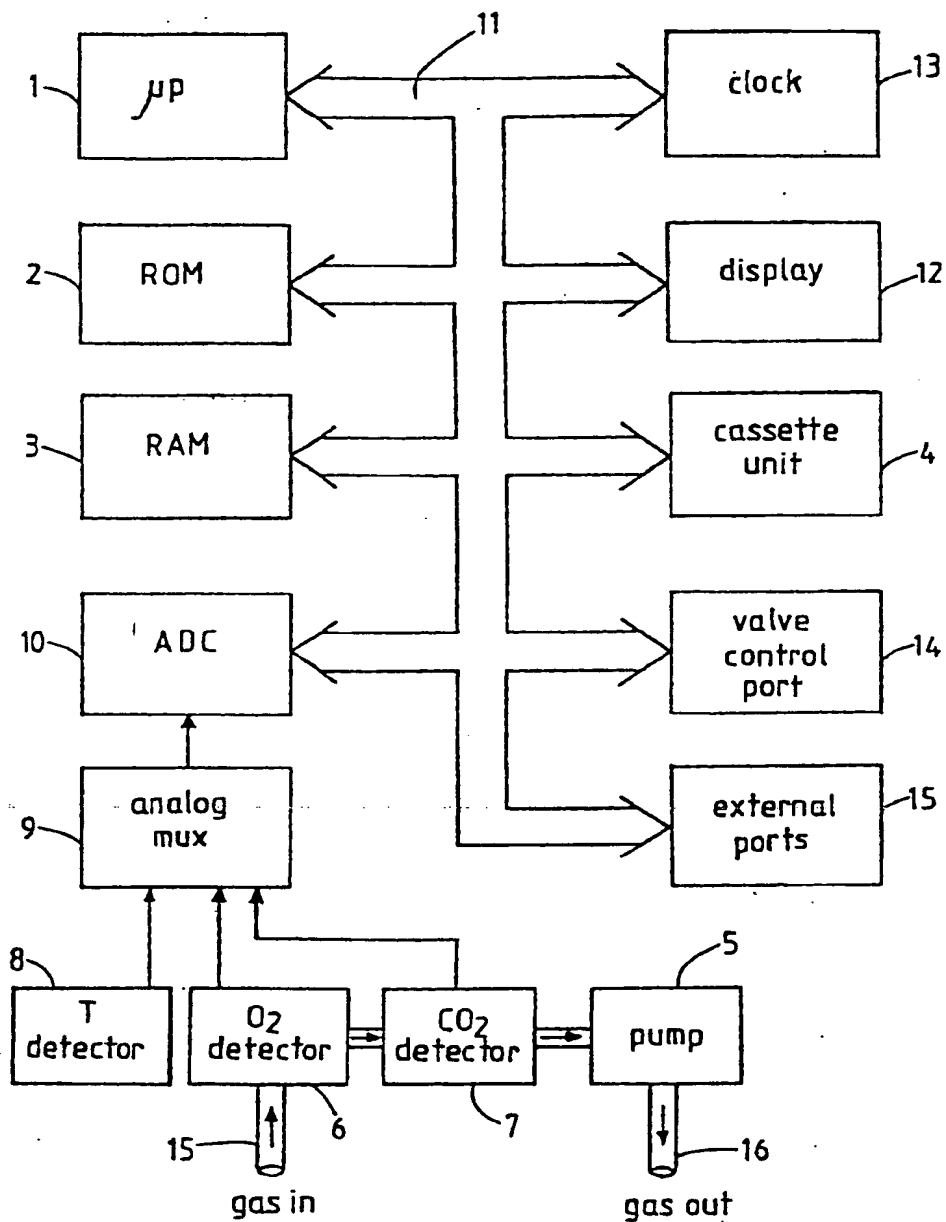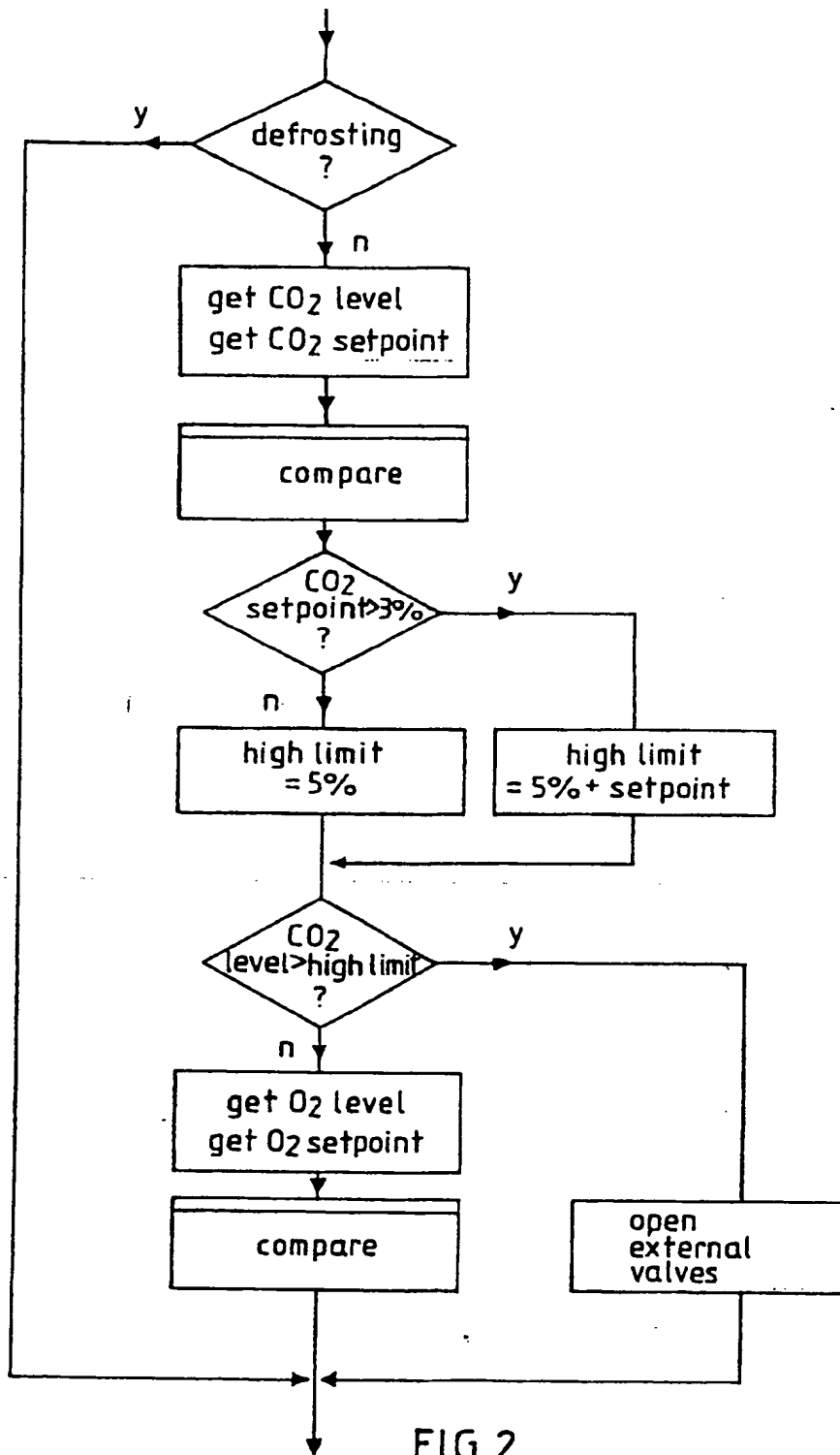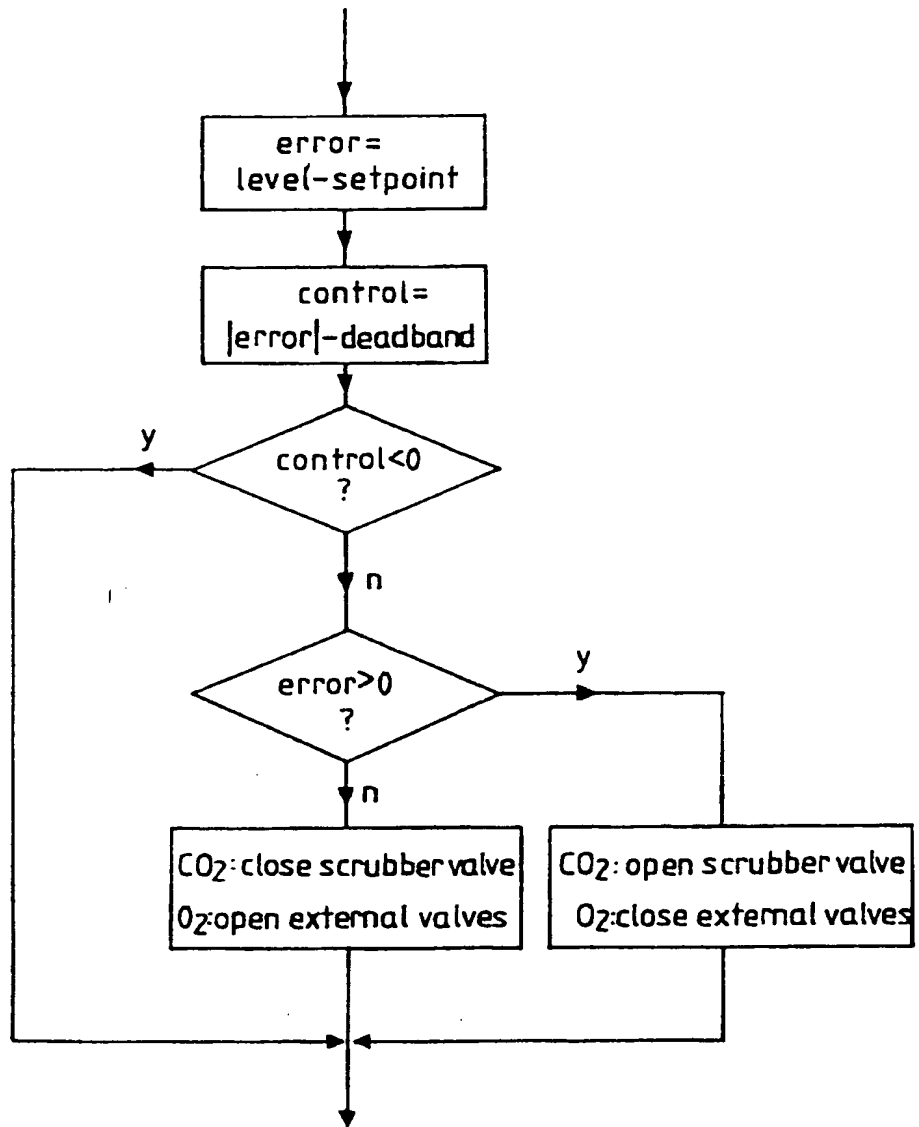
FIG. 1

FIG.2

```
          ┌─────────────────┐
          │     error=      │
          │  level-setpoint │
          └─────────────────┘
                   │
                   ▼
          ┌─────────────────┐
          │    control=     │
          │ |error|-deadband│
          └─────────────────┘
                   │
                   ▼
        y        ◇ control<0 ◇
     ◄───────────◇     ?     ◇
                   │
                   │ n
                   ▼
                 ◇ error>0 ◇         y
                 ◇    ?    ◇ ──────────►
                   │
                   │ n
                   ▼
   ┌──────────────────────────┐   ┌──────────────────────────┐
   │ CO₂: close scrubber valve│   │ CO₂: open scrubber valve │
   │ O₂: open external valves │   │ O₂: close external valves│
   └──────────────────────────┘   └──────────────────────────┘
```

FIG. 3